Contributions from the Queensland Herbarium No. 12.

IDIOSPERMUM (IDIOSPERMACEAE), A NEW GENUS AND FAMILY FOR *CALYCANTHUS AUSTRALIENSIS*

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SUMMARY

Idiospermum australiense (Diels) S. T. Blake is based on *Calycanthus australiensis* Diels following the rediscovery of this species previously known only from one imperfect specimen now lost, the description based on it, and a sketch of a leaf and flower. The embryos in the recently collected material with three or four distinct very large peltately attached fleshy cotyledons are quite unlike those of any described family; the very many spiral tepals associated with a hollowed receptacle and a single carpel and laminar stamens with exalbuminous seeds are unique combinations of characters. *Idiospermum* occupies an isolated position in the Magnoliales.

In 1912 Diels described *Calycanthus australiensis* from a specimen he had collected in northern Queensland at Harvey Creek near the Russell River not far from " Hickey's " on 6 June 1902.

Diels stated that his attention was drawn to the species by the presence of fallen flowers on the floor of the then scarcely disturbed rain forest. He found only one tree and was unable to get a flowering twig. He did succeed in getting a leafy twig and this with flowers picked up from the ground constituted his specimen. When he came to examine the flowers after his return to Berlin he found the interior parts mostly damaged by insects and could not examine the nature of the staminodes or the number of carpels. However the twig with four inverse cortical bundles, opposite leaves, simple hairs (to be seen only on the youngest parts), numerous perianth parts spirally imbricate on the outside of a cup-shaped receptacle with stamens at the top, staminodia inside and carpels at the bottom of the cup with no more than two ovules led him to the conclusion that the species belonged in *Calycanthus*.

Diels stressed the phytogeographical interest of this discovery because the Calycanthaceae had a peculiar distribution in that *Calycanthus* itself was previously known only from two or three species in the south-western and eastern United States (California, Pennsylvania to Mississipi and Florida) and the only other genus *Chimonanthus* with three species was restricted to China. Although the Australian species had a few peculiarities such as its tree habit (the others are shrubs) and some anatomical differences Diels thought that it was a connecting link between *Chimonanthus* and *Calycanthus* and that its characters supported the opinions of those who believed that these were not generically distinct.

Since then another genus, *Sinocalycanthus* (Cheng & S. Y. Chang) Cheng & S. Y. Chang (1964) has been described from China, closely resembling *Calycanthus* with one species.

The identity of *Calycanthus australiensis* has always been a mystery to Queensland botanists in spite of the fact that considerable collecting has been done in the area around Harvey Creek and Russell River. There is in Brisbane a tracing of a leaf and sketch of a flower from the type annotated by Diels (Fig. 9), but the specimen has now been lost and no other specimen resembling the sketch has been found until very recently. Most of the land near the junction of Harvey Creek and the Russell River has been converted to fields of sugarcane since the 1920s but thanks to a letter from Mr. W. Kearns of Babinda to my late colleague Mr. L. S. Smith we now know that boats used to come up the Russell River and anchor at the mouth of Harvey Creek, and that " Hickey's " catered for the travellers.

In August 1971 four cattle died on a property north-east of Daintree and two more shortly after, all with symptoms suggesting poisoning. A post mortem examination of the latter two was carried out by Mr. D. C. Clague (Divisional Veterinary Officer at Cairns) and Mr. R. G. Cameron (Inspector of Stock) and many large " seeds " were found in the stomachs of both animals. Similar " seeds " were found under a tree in the same paddock from which a flowering twig was obtained and this together with " seeds " and a specimen of the stomach contents was sent to the Herbarium for search and opinion on the presence of possible toxic plants. The flowering specimen appeared to belong to the long-lost *Calycanthus australiensis* but the " seeds " were quite unlike those of *Calycanthus*. On a later visit Mr. Clague found an old fruit with most of the internal parts destroyed, but in his anxiety for his cattle the owner had now cut down the tree and destroyed any remaining " seeds ". I visited the property about a fortnight later and was able to get a number of reasonably good flowering specimens from the fallen tree after soaking out dead twigs in hot water and also a considerable number of individual flowers (Fig. 4, a–c). By searching the ground in a strip of rain forest along the near-by creek " seeds " from four other trees were found, one of which was sacrificed in the hope of getting better flowering material; good specimens with last year's fruiting peduncles and quite young leaves were obtained but most of the few flowers were past anthesis. This locality is about 100 miles north of the type locality which I searched two days later without success.

It was now known that the so-called seeds were in fact naked embryos with three or four massive fleshy cotyledons. The material collected from beneath the other trees, about twenty-five " seeds " in all, some with developing radicles and some also with conspicuous plumule mostly have four cotyledons. Several seedlings from last year's crop were also found and these still had four or three withered cotyledons attached (Figs. 6, 7).

A second occurrence still farther north was found a few weeks later by Dr. L. G. Webb and Mr. J. G. Tracey of the Rain Forest Ecology Section of C.S.I.R.O. who collected embryos from the ground and a seedling. Specimens from this locality with fruits and young buds were collected by Mr. B. P. M. Hyland, Commonwealth Forestry and Timber Bureau, Atherton, shortly before this paper went to press.

The material now available shows that the species differs from *Calycanthus*, *Chimonanthus* and *Sinocalycanthus* in several ways. The cotyledons (Figs. 6, 7) are very different from the two foliaceous convolute cotyledons of the northern species; there is usually only one carpel (rarely two) with a broad fleshy almost sessile stigma (Fig. 8) instead of numerous carpels with long slender styles and decurrent stigmas; the stamens are much more petal-like with a very short broad and thick filament, broad connective with a long incurved sterile apex and conspicuously dorsal anthers; the pollen is monosulcate instead of dicolpate; the direction of the tertiary veins of the leaf is transverse to the midrib rather than to the secondary veins (Figs. 2, 3, 5, 9, 10), forming transversely elongated polygonal areas, with few free vein-endings in the final reticulum (Fig. 10) instead of the many endings figured by Nicely (1965, fig. 3); the structure of the wood is very different. [The pollen is dicolpate—see Postscript, p. 11.]

The increased number of cotyledons is noteworthy. Three foliaceous cotyledons are usual in Degeneriaceae (with one species, *Degeneria vitiensis* in Fiji) but four sometimes occur (Swamy 1949) and very rarely two (Cronquist 1968, p. 112). Embryos or seedlings with more than two cotyledons have been found in many families almost always as occasional teratological states (Compton 1913), but polycotyledony due to fission of two foliaceous cotyledons seems to be a regular feature of some genera of Loranthaceae (Engler 1926, Fletcher 1909), some species of *Persoonia* (Proteaceae) in which up to eight cotyledons have been reported (Gaertner 1807, Brown 1810, Fletcher 1909 with other references), in at least one species of *Pittosporum* (Pittosporaceae) (Lubbock 1892, Thomas 1914) and also in a few species of *Cola* (Sterculiaceae) with fleshy cotyledons (Masters 1868, Dalziel 1937; also Lubbock 1892, pp. 170–1, species not identified), but according to Schultze-Motel in Engler (1964) there are only two very deeply lobed cotyledons*. The four or three quite distinct massive subsessile cotyledons peltately attached in a single whorl seem to be quite unlike those of any other family hitherto described. This peculiar embryo and the distinctive wood therefore make it necessary to describe not only a new genus but also a new family for *Calycanthus australiensis*. The generic name *Idiospermum* is derived from the Greek words ἰδιος (idios) peculiar, distinct and σπερμα (sperma) a seed.

Idiospermaceae, familia nova characteribus generis *Idiospermi*, ob torum profunde concavum tepala multa spiralia, stamina spiralia superiora sterilia, ovarium perigynum 1–2-ovulatum, semen exalbuminosum, folia opposita, ramulos fasciculis 4 vascularibus corticalibus inversis, chromosomatis 22 (2*n*) praeditos Calycanthaceas revocat, sed tepalis a bracteis valde distinctis, staminibus laminiformibus apice longe sterili antheris conspicue dorsalibus, carpello pro more unico (raro geminato), stigmate subsessili dilatato fructu semineque diversis inter alia differt atque ob embryonem (magnum in semine exalbuminoso situm) cotyledones 4 vel 3 magnas carnosas peltatas gerens a familiis omnibus huc descriptis conspicue diversa.

Genus unicum ideoque familiae typus: *Idiospermum* S. T. Blake

* Mr. M. J. E. Coode has drawn my attention to the presence of 3–5 fleshy cotyledons in *Terminalia megalocarpa* Exell (Combretaceae) from the Solomon Islands and kindly sent fresh fruits from a tree growing in the Botanic Gardens at Lae. The cotyledons are petiolate and very much contorted as usual in the genus, but they are not symmetrically arranged and the increased number (3 and 4 in those examined) is almost certainly the result of deep fission of two.

Idiospermum S. T. Blake, genus novum.

Tepala multa spiraliter et subtriseriatim disposita, colorata, exteriora tenuia latiora, cetera crassa, toro crasso anguste cupuliformi tubum perianthii simulante extus inserta, imbricata. Stamina spiraliter disposita exteriora ad apicem tori ejus faucem claudentia, interiora sterilia facie interiore tori sita gradatim breviora, gradatim distantia; filamenta latissima crassissima brevissima; connectivum latum extra antheram longe productum. Antherae in dorso connectivi sitae, protuberantes, 2-loculares loculis extrorsis longitudinaliter dehiscentes. Pollinis grana ambitu elliptica, dicolpata. Carpellum unicum vel interdum alterum additum basi cavitatis tori insertum, sessile, clausum; stigma terminale fere sessile dilatatum carnosum. Ovula solitaria vel 2, basalia anatropa erecta; integumenta 2. Fructus indehiscens sed vi lapsus frangens, magnus, subglobosus, 1- raro 2-spermus, e toro aucto fere clauso partim constructus; pericarpium tenue. Semen erectum magnum exalbuminosum; testa tenuissima, embryo rectus; radicula infera; cotyledones 4 vel 3, magni, solidi, carnosi, fere sessiles peltati, lateribus fere planis erectis sese appressi, dorso ubique convexi. — Arbor sempervirens, leviter aromatica cellulis oleosis gerens; ramuli fasciculis vascularibus 4 inversis corticalibus intra annulum sclerenchymatosum sitis. Gemmae nudae (perulis carentes) cum inflorescentia pilis simplicibus brevibus unicellularibus pubescentes. Folia opposita, vernatione conduplicata, glabra, petiolata, simplicia, integra, minute punctata, penninervia nervis (cum costa decurrentibus) camptodromis tertiis ± horizontalibus cum reticulationibus nonnullis utrinque elevatis. Stipulae 0. Inflorescentia axillaris pro more 1-flora, appresse pubescens; pedunculus tenuis paribus distantibus bractearum decussatarum parvarum praeditus. Flos supra bracteas supremas fere sessilis subarticulatus. Tepala exteriora mox caduca eorum basibus prominentibus persistentibus interiora persistentia. Staminodia exteriora subpetaloidea ad stamina fertilia appressa, intima distantia parva cuculliformia. Pedunculus sub fructu valde incrassatus recurvus.

Typus: *I. australiense* (Diels) S. T. Blake (*Calycanthus australiensis* Diels) species adhuc nota unica pluviisilvae in Queenslandia boreo-orientali incola.

The outstanding characters of the family are as follows:—

Evergreen tree with ethereal oil cells, four inverse cortical vascular bundles, unilacunar nodes and single leaf-traces. Leaves opposite, exstipulate, petiolate, entire, with a single layer of palisade tissue, rubiaceous stomata and pinnate camptodromous veins. Inflorescence axillary, 1-flowered; peduncle with several decussate bracts. Flower spiral, the cup-shaped receptacle bearing very many closely packed tepals on the outside from the base upwards, many fertile stamens on the top, less closely arranged staminodes on the inside and 1 rarely 2 carpels at the bottom. Outer tepals soon falling away, leaving persistent bases; inner tepals narrower, persistant. Fertile stamens tepal-like, thick with almost no filament, the anthers dorsal, narrower and much shorter than the stamen with two long narrow protuberant cells opening extrorsely. Pollen dicolpate. Carpels about sessile; stigma nearly sessile, thick, broad and fleshy; ovules 1 or 2, anatropous with 2 integuments, basal, the first with a very short funicle, the second (if present) beside

it with a longer funicle. Fruit indehiscent consisting of the greatly enlarged subglobose almost closed brittle receptacle crowned by the persistent inner tepals completely surrounding and appressed to but free from the matured carpel. Pericarp thin. Seeds 1 or 2 filling the carpel, the second smaller; testa very thin ± adhering to the pericarp; endosperm 0; plumule, hypocotyl and radicle short, hidden by the 4 or 3 whorled ± symmetrical massive fleshy peltately attached subsessile cotyledons, or the radicle shortly exserted.

Idiospermum australiense (Diels) S. T. Blake, comb. nov.

Calycanthus australiensis Diels, Bot. Jahrb. 48, Beibl. 107: 10 (1912). Type: Queensland, Russell River region near Harvey Creek, not far from " Hickey's ", 6 June 1902, *Diels* 8548 (B, now lost; tracing of leaf and enlarged sketch of a flower (Fig. 9), BRI).

Evergreen tree up to ± 15 m high, ± 50 cm diam with a few buttresses up to ± 1 m high, their margin slightly concave in profile. Trunk slightly flexuose; bark light grey densely lenticellate with vertically elongated irregularly grouped lenticels and also sparsely scabby-scaly, pale cream inside. Wood with vessels, very pale coloured. Twigs quadrangular, glabrous, nearly smooth, the courses of the cortical bundles shown by raised lines even on branches several years old; nodes unilacunar with a single leaf-trace. Buds sparsely appressed pubescent with short, ± slender, acute hairs without silicified support cells and soon disappearing. Leaves opposite, decussate but often apparently distichous by the abortion of alternate pairs, very early glabrous; petioles deeply channelled on the upper surface, 1·2–2 cm long, with one large arc-shaped vascular strand and two small lateral ones; blades green and slightly shining above (more so when fresh), paler beneath and shining with a somewhat metallic sheen, pusticulate on both sides when dry because some epidermal cells have sphaeroidal crystals or clusters of crystals apparently of silica usually above veins, somewhat narrowly oblong or also somewhat elliptic, shortly acuminate with an acute or narrowly obtuse tip, acute or somewhat attenuate at base, entire, thinly rigidly coriaceous with a thick cuticle and thickened margins, pinnately veined with the midrib and most veins raised on both sides with sclerenchymatous sheaths the major veins vertically transcurrent, the midrib channelled towards the base on the upper side, medianly ridged beneath, lateral veins in (7–) 9–15 pairs at an angle of 50°–60° with the midrib and shortly decurrent to it, curved for the greater part of their length, camptodromous, sometimes with 1 or 2 minor lateral veins between, tertiary veins about transverse to the midrib tending to recurve outwards, some proceeding from the midrib to secondaries (laterals), others from secondaries to secondaries often continuing across a secondary to the one below, branched or not, with anastomoses between, the islets polygonal, mostly transversely so and within these a reticulum completely immersed in the mesophyll with free vein-endings, ± 12–24 cm long including the acumen of ± 5–12 mm, ± 9–15 cm wide, mostly 2·5–3·5 times as long as wide. Inflorescence axillary, 1 (or more?)-flowered; peduncle slender, 2–4 cm long, finely densely pubescent with the hairs becoming ferruginous, with 2–4 distant pairs of pubescent, broad, decussate bracts, the lower ones very small, the others increasing in size upwards, the topmost elliptical, concave ± 9 mm long, the middle pair or pairs

sometimes with axillary buds (?potential flowers), early deciduous leaving prominent scars, the peduncle in fruit much enlarged up to 1 cm diam., up to 7·5 cm long. Flower about sessile and ± articulate above the top pair of bracts, ± 1 cm long, 1·5–2 cm wide if fully expanded. Receptacle with thick, woody walls, deeply narrowly cup-shaped within, ± 5–6 mm long, ± 5–6 mm wide, densely pubescent. Tepals dull purple except for a grey short appressed pubescence on the back, very many (± 30–40), spirally arranged, triseriate, imbricate and covering the outside of the receptacle, those towards the base elliptic concave densely pubescent outside up to 12 mm long and 8 mm wide, succeeding ones gradually smaller and less hairy, the intermediate ones ± narrowly elliptic-obovate ± 10 mm long and 4 mm wide, all soon deciduous leaving persistent hairy bases, about 15–18 upper ones persisting on the developing fruit about narrowly oblong or somewhat spathulate, acute and, especially the innermost, shortly acuminate, still less hairy outside and the innermost nearly glabrous, ± 7–8 mm long, ± 2·5–2·7 mm wide. Stamens ± 13–15 at the top of the receptacle, inflexed and ± covering its opening, ± 2·7–3 mm long, subtriangular in surface view, ovate falcate in side view, inflated and at least sometimes hollow; anthers dorsal, extrorse, the cells linear extending from about the base of the stamen to beyond the middle and a little distant from its margin so that the connective extends beyond the cells both laterally and apically. Staminodes various, those next to the stamens not very different in form and size from them and set close to them, hollow, ± 8–10 gradually more distant on the inside walls of the receptacle almost to its base, becoming progressively smaller and hood-shaped. Carpel usually 1 rarely 2, sessile at the hairy base of the receptacle (which is the top of the axis), glabrous, obovate, compressed, ± 1·5–2 mm long. Stigma nearly sessile, ± 0·7 mm long, irregularly ovoid, fleshy, papillose. Ovule 1 with a very short funicle or sometimes 2, the second with a longer funicle. Fruit olive brown, depressed globose, relatively very large, ± 5–5·5 cm high, 6–6·7 cm wide, formed in part by the much enlarged but comparatively thin externally crustaceous internally somewhat fleshy almost entirely closed receptacle crowned by persistent tepals and stamens, the external surface minutely densely pubescent, granulate-reticulate, also faintly tessellate and faintly vertically rugulose. Pericarp thin, tightly appressed to but free from the inner wall of the receptacle, the opposing surfaces shining brown. Seed usually 1, sometimes 2, filling the cavity, depressed globose (variously compressed if two mature), ± 4–5 cm high, ± 5–6 cm wide; testa membranous, ± adhering to the pericarp, tending to disappear; embryo filling the seed; plumule and hypocotyl stout, surrounded by the 3 or more usually 4 massive fleshy peltate cotyledons in a single whorl similar or nearly so unless a second seed is present, appressed with slightly wavy margins, nearly flat ± vertical sides and smoothly rounded backs. Embryo set free from the fallen fruit by the decay of receptacle, pericarp and testa, 80–160 g in weight, the cotyledons persisting on the seedling for a year or more. Early leaves spiral or decussate, scale-like; first true leaves opposite (rarely ternate) ± resembling the adult leaves but with fewer veins, the tertiary ones much less conspicuous. Chromosome number: $2n = 22$ (from root-tips and stamens; Henderson, unpublished).

QUEENSLAND.—Cook District: Arsenic Creek between Noah Creek and Cape Tribulation, in complex mesophyll vine forest, alluvial soil derived from metamorphic rocks, Oct. 1971, *J. G. Tracey in V. K. Moriarty* 850 (tree ± 15 m high and 90 cm girth; stem somewhat fluted—*embryos and one*

seedling); N. of Noah Creek, ± 16° 10′ S., ± 145° 10′ E., in rain forest, ± 10 m, 10 Apr. 1972, *Hyland* 2569 R.F.K. (tree 20 m high, 60 cm d.b.h., with slightly flaky bark and buttressed trunk; lenticels pale; blaze cream darkening on exposure and emitting an odour that defies description; bark rather bitter when chewed; fruit olive-brown—*fruits, young flower buds*). NE. of Daintree, WNW. of Bailey Point, on bank of Mackenzie Creek in rain forest, ± 25 m, 21 Sept. 1971, *Blake* 23621 (tree ± 15 m high with fairly narrow slightly concave short buttresses up to 1 m high; trunk slightly flexuous; bark pale grey densely lenticellate also sparsely scabby-scaly; wood very pale; leaves shining green, paler and more metallic beneath; petals dull brownish purple, somewhat greyish outside—*flowers, embryos from beneath three trees, some with remains of testa and pericarp, in various stages of germination, seedlings from last season's fruit, wood, bark*); same locality from one of these trees, Aug.–Sept. 1971, *D. C. Clague* (tree 18 m high; trunk ± 20 cm diam.—*flowers, embryos* one *damaged fruit, wood, bark*); same locality, 12 Sept. 1971, *D. C. Clague* (sterile shoot from another tree); same locality, former rain-forest area now cleared and grassed, 30 m, 11 Apr. 1972, *Hyland* 5997 (tree 20 m high, 60 cm d.b.h.—*very young buds*); near Harvey Creek [near its junction with the Russell River] in rain forest, 6 June 1902, *L. Diels* 8548 [tree of 10 m with yellow green bark—*sterile twig, loose flowers*].

All the specimens are from trees in rain forest on old alluvia in localities with an average annual rainfall exceeding 3000 mm (125 in) with a relatively dry period in the months July to October the monthly average for the driest month being about 100–130 mm (2·6–3·3 in).

Mr. W. J. Smith has examined the wood and finds it quite distinctive. He has kindly given me some notes to complete my description of the genus and will publish a detailed account elsewhere.

Wood creamy-coloured, streaked often in greenish tints, diffuse porous, faintly aromatic but without oil cells, fumes with ammonia; vessels medium, solitary or in short radial multiples of up to 3, without spiral thickening, with cream to yellowish deposits as well as tyloses; vessel perforations multiple, scalariform; parenchyma abundant, vasicentric and paratracheal in continuous bands or in shorter bands extending from vessel to vessel and confluent, and with some tendency to apparent terminal banding; rays up to 20 cells high, mostly 1–2 sometimes 3 cells wide, composed almost entirely of procumbent cells with 1–2 rows of marginal upright cells; vasicentric tracheids absent.

This is quite different from the wood of Calycanthaceae which is described by Metcalf and Chalk (1950, p. 15) as being ring-porous or semi-ring-porous with very small very numerous vessels in clusters and radial pore-multiples that are grouped to give a distinct oblique or ' flame-like ' pattern with simple oblique perforations; very scanty parenchyma of a few cells around the vessels; small low rays that are heterogeneous but with few truly procumbent cells; and with vasicentric tracheids. There is some resemblance to some members of the Lauraceae and Magnoliaceae but both of these have oil cells in the wood while the former has vasicentric tracheids and the latter has spiral thickening on the vessels and terminal parenchyma. There is a superficial resemblance to the Anacardiaceae because of the greenish streaks in the pale-coloured wood and some genera in this family have scalariform perforation plates. The odour, the yellow deposits in the vessels and the fuming with ammonia recall *Gmelina* (Verbenaceae).

In his account Diels mentioned that the leaves resemble those of the northern species in having oil cells, one layer of palisade tissue, epidermal cells with wavy walls

and stomata of the same type (that is, rubiaceous) restricted to the lower surface. In the twigs (Fig. 8n) there is a closed cylinder of stone cells with U-shaped thickening, within which are the cortical bundles as in *Chimonanthus* but there is no complete ring in *Calycanthus*. He drew attention to a few differences from the northern species which he regarded as relatively unimportant—hairs (only to be seen on young growth) without silicified supporting cells, no woodiness in the pith, very uniform cells in the exterior cortical tissue, greater amount and proportion of xylem in the cortical bundles, higher medullary rays, and spherical crystals in the pith and the bark. The tree habit seemed to him to be of more importance because all the other species are shrubs.

Hutchinson (1959, 1964) referred the Calycanthaceae to the Rosales because of the opposite leaves and absence of endosperm and probably also because of the perigynous ovary and achene-like partial fruits, ignoring the spiral perianth, dicolpate pollen and anatomy of the stem. Baillon (1869) treated the group as a tribe of the Monimiaceae. The family has more often been treated as one of the families allied to the Magnoliaceae with which the perianth, anatomy, pollen and presence of oil cells are in much better agreement. The inverse cortical bundles are noteworthy, but Metcalfe and Chalk (1950, p. 1342) list thirty-seven families of quite diverse relationships in which cortical bundles have been found and among these inverse bundles are known from such diverse families as Barringtoniaceae (all genera) and Chenopodiaceae, as well as Calycanthaceae.

Differences between *Idiospermum* and the Calycanthaceae have been described above but the spiral perianth and androecium, laminar stamens with long narrow anther-cells, dicolpate pollen and production of oil cells likewise point to a relationship to families of the Magnoliales whether taken in the broad sense of Thorne (1968, as Annonales) and Cronquist (1968) or in the restricted sense of Takhtajan (1969 as Annonales) and Hutchinson (1959, 1964). The cup-shaped receptacle and usually solitary ovule suggest a relationship to Eupomatiaceae (in Annonales by Hutchinson), Lauraceae and Monimiaceae (in Laurales by Hutchinson and Takhtajan), the usually single carpel and opposite leaves agree with some genera of the Lauraceae and Monimiaceae though the perianth and stamens do not, and the fruit is not unlike that of *Cryptocarya* (Lauraceae). In addition to the structure of the embryo and the wood two combinations of characters appear to be unique to *Idiospermum*—numerous spiral tepals, hollowed receptacle and a single carpel, and laminar stamens and absence of endosperm. The genus appears to be as isolated as *Austrobaileya*, *Degeneria*, *Eupomatia* and *Galbulimima* (*Himantandra*).

The three vascular strands in the petiole run throughout its length. The larger crescentic one is derived from the stele of the stem and passes into the midrib; it appears to be truly simple and not the result of the fusion. The small lateral traces near the horns of the larger one are derived entirely from the cortical bundles and pass directly into the base of the blade (sometimes one of them very briefly uniting with the central strand) and become the slender basal lateral veins. These basal veins may be at first somewhat distant from the margin with branches running to it as well as to the midrib but they soon lie close to the marginal sclerenchymatous strand and

disappear below the middle; a relatively long erect branch and a few smaller ones are jammed between the vein and the margin. This structure was seen in crown leaves (Fig. 8p) and in the early leaves of seedlings. In a young leaf of *Chimonanthus praecox* the lateral traces divide into two in the upper part of the petiole; the inner branch runs into the central trace and forms part of the first lateral vein while the other branch divides in the blade and anastomoses with this lateral vein forming a reticulum between it and the margin; the arrangement in *Calycanthus occidentalis* is much the same but only one leaf of each was examined.

On a few twigs peduncles were found in the axils of the topmost pair of leaves with the vegetative bud still quite small so that the peduncles at first sight appear terminal. The flower is rather easily broken away immediately above the topmost pair of bracts and this line of weakness is the line of abscission of the fruit as seen on the persistent fruiting peduncles (Fig. 5).

The first two tepals (Figs. 3, 4b) are apparently opposite, equal and deeply concave, and enclose the flower in bud. They might be regarded as bracteoles at the base of the receptacle in a plane at right angles to the bracts but they appear to be the first members of two spires of tepals while a third spire begins a little above and between (not half way). The lower tepals (Fig. 4a) differ from the upper in being broader, thinner, more hairy on the back, early deciduous and having five (or sometimes seven?) vascular traces in the persistent bases; the upper ones have three traces. Stamens and staminodes appear to have one trace only. The innermost " staminodes " look more like reduced open carpels. Hiepko (1965) suggested that the staminodes of *Calycanthus* were really carpellodes.

The floral parts have the dull purple colour reported to be connected with pollination by beetles and found in *Calycanthus*, *Eupomatia*, etc., (cf. Eames 1961, Hotchkiss 1958) but I have found nothing resembling the food-bodies described and figured for these (e.g. Eames 1961, Nicely 1965) unless the fleshy papillate stigma is one; the interior parts of some flowers had certainly been extensively damaged by biting insects. The flowers have no pronounced odour. [See also p. 11.]

The setting free of the embryo by the decay of the walls of fruit and seed must be an uncommon phenomenon and the large 3- or 4-parted embryos are conspicuous objects on the forest floor. The cotyledons of any one embryo are usually very much alike (Fig. 6). Asymmetric embryos or embryos with irregular cotyledons or embryos with a depression on top suggest 2-seeded fruits (Figs. 6f, 7d) and in two ovaries I found two ovules, but I could not verify Diels's statement that the second ovule degenerates, turns upside down and acts as an obturator. In one flower I found two carpels each with one ovule and from such a flower two seeds may be produced and these could be expected to have the sides facing one another much compressed.

When first collected some of the embryos had large fragments of the testa pericarp and receptacle adhering to them but these parts soon began to fall away (Figs. 6j, a, b). The structure of the fruit and seed was deduced from these and the damaged shell of a probably immature fruit collected by Clague before two fresh fruits were received from Hyland which had the receptacles thinner than expected and so brittle that they cracked open when they fell (Fig. 12).

Detached cotyledons show the point of attachment to be a vertical elliptic area on the angle between the sides about a fifth to a third the height of the cotyledon from its base (Fig. 6h (*a*)). A transverse section of the node shows four or three evenly spaced gaps in the vascular system, one opposite each point of attachment; the outline of the stele is square or triangular, according to the number of cotyledons.

The cotyledons contain an oil and a substance toxic to ruminants producing symptoms similar to those produced by strychnine.

The seedling produces several scale leaves before the first pair (sometimes triad) of true leaves (Figs. 1, 7). One example with three cotyledons and the plumule still shorter than the cotyledons has all visible scale leaves in whorls of three (Fig. 7b), the others have them decussate or spiral or mixed in no apparent order, but some embryos had germinated lying on their side or upside-down (Fig. 7c) and the variations may be the result of differential growth of the shoot as it attained an upright position.

Each cotyledon has a bud in its axil and one of these buds may develop simultaneously with the plumule (Fig. 7c). The main cotyledonary strand elongates vertically as it leaves the stele and immediately branches, one branch running into the axillary bud and rebranching along the way while the others diverge into the cotyledon. There appear to be strands in the node corresponding to cortical bundles but their courses were not followed.

ACKNOWLEDGEMENTS

The rediscovery of the species is due to the combined action of Mr. J. V. Nicholas, the owner of the cattle, Mr. D. C. Clague and Mr. R. G. Cameron. By their help I was able to collect the additional material on which much of the above account is based. Mr. J. H. Willis, National Herbarium of Victoria, Melbourne, supplied material of *Calycanthus* and *Chimonanthus* for comparison. I am grateful to Prof. Dr. Th. Eckardt (Director) and Dr. G. Hiepko (Botanischer Garten und botanisches Museum, Berlin) for the information concerning the loss of Diels's specimen and to Mr. T. G. Hartley, Herbarium Australiense, Canberra, for a copy of the protologue of *Sinocalycanthus*. The description of the wood was prepared by Mr. W. J. Smith, Forest Products Research Branch, Queensland Department of Forestry, Brisbane. One of my colleagues, Mr. R. J. F. Henderson, examined the stomata and chromosomes and another, Mr. A. Bolin is responsible for cutting sections and the photography of the flowers and the black-and-white enlargements of my colour transparencies. I am grateful to Mr. W. T. K. Hall (Director of Pathology Branch, Animal Research Institute, Brisbane) for permission to publish the statement concerning the toxicity of the cotyledons.

POSTSCRIPT

While this paper was being printed specimens with buds and flowers were received from the two localities cited on pp. 6–7. According to the notes to *Webb & Tracey* 10745 (May 1972) from the same locality as *Tracey in Moriarty* 850 the species is " a common tree in this area reaching approx. 40 m high and 90 cm diameter ". The second collection was collected on 21st June 1972 by J. V. Nicholas from one of the trees that I examined and sent fresh. Mr. Nicholas wrote that the flowers do not last long and that they are white when first open and then turn bright red, a change that could be seen on the material received; they have a faint scent of withered rose petals. The lower and middle tepals soon fall and the persistent upper ones then become the dull brownish purple described for *Blake* 23621. Buds just before expansion are creamy white, ellipsoid-globose, ± 1·5 cm diam.; the open flower is about broadly elliptic to depressed elliptic in outline ± 3–3·5 cm long and 2–4 cm wide with petaloid tepals, the lower ones ± reflexed 18–24 mm long and 8–11 mm wide, the middle ones spreading. The stamens are not hollow at this stage nor is the receptacle noticeably woody. Some inflorescences are 3-flowered. (Fig. 13.)

Pollen from *Webb & Tracey* 10745 was acetolyzed and examined by Mr. C. J. E. Bell, Botany Department, University of Queensland. It proves to be dicolpate, not monosulcate as previously thought, and so resembles that of *Calycanthus*, *Eupomatia* and some genera of the Monimiaceae and Annonaceae.

The locality at Oliver Creek (Arsenic Creek), a tributary of Noah Creek is approx. 16° 06′ S., 145° 27′ E., that at Mackenzie Creek is 16° 12′ S., 145° 25′ E., and the type locality at Harvey Creek is 17° 15′ S., 145° 56′ E.

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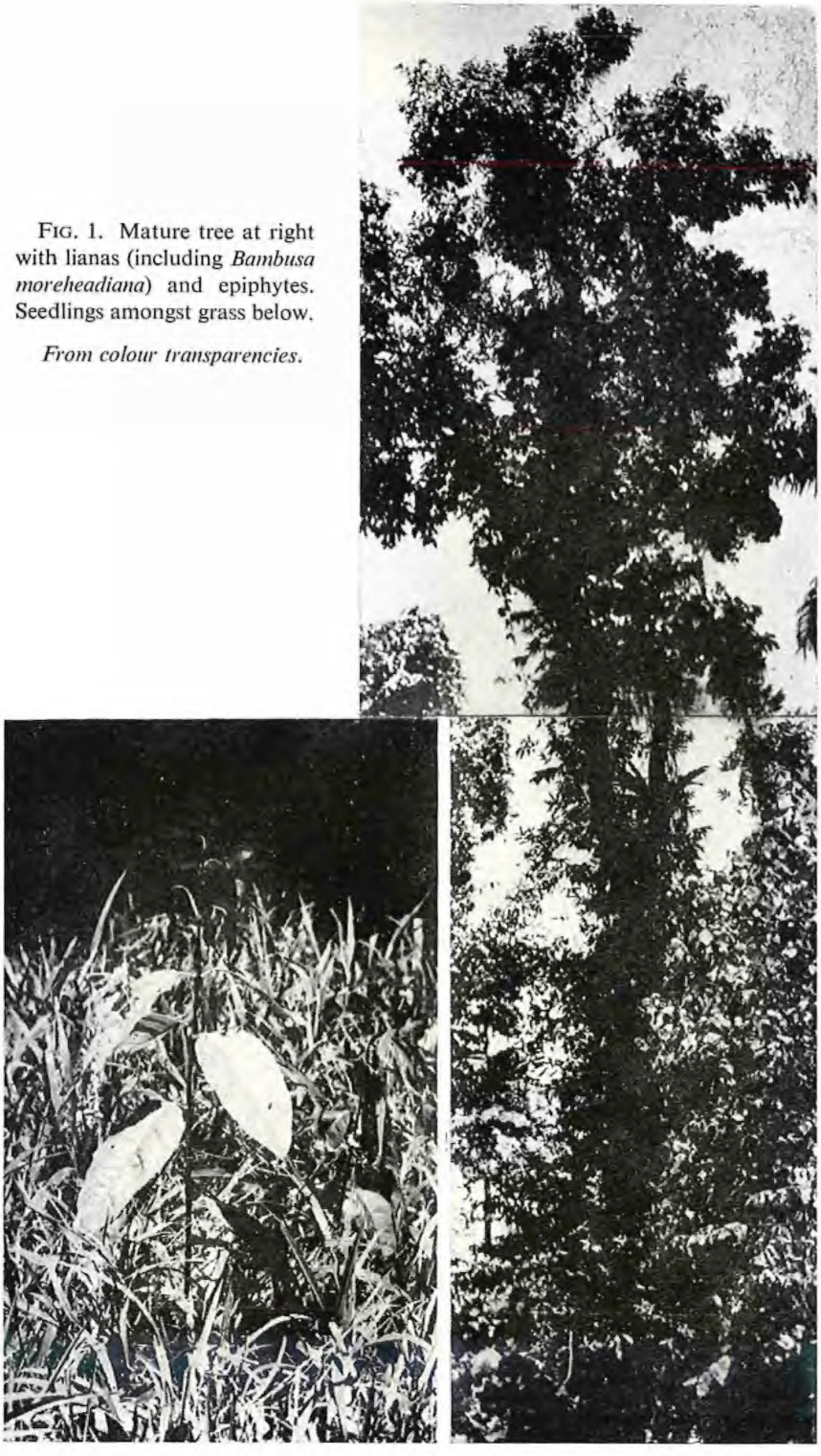


FIG. 1. Mature tree at right with lianas (including *Bambusa moreheadiana*) and epiphytes. Seedlings amongst grass below.

From colour transparencies.

FIG. 2. Flowering twig, half natural size (see also Fig. 3).

FIG. 3. Flowering twig, half natural size (see also Fig. 2). The single flower has the two lowermost tepals still attached and reflexed while those immediately above have fallen. At upper right is part of the lower surface of a leaf nearly twice natural size.

FIG. 4. Flowers (see also Fig. 8). a, flower (or bud) with most tepals still attached, one of the lowermost (behind) fallen away but held by cobwebs; b, flower with one lowermost tepal attached, the other lower tepals fallen away and some upper ones broken away; c, expanded flower from above with all persistent tepals; d, fully developed flower with incurved tepals, peduncle with a pair of axillary buds; e, vertical section through a flower well past anthesis with developing seed. a–d, × 4; e, × 3; a–c from dead tree (see text); d, e, from flowers pickled when fresh.

Photos: A. Bolin.


a
b
c
d
e

FIG. 5. Twigs with fruiting peduncles after fruit has fallen, half natural size.

FIG. 6. Embryos (a–g), half natural size; a, b, e, f, from above; c from the side; d, g, from beneath; f with a concavity on top suggesting the presence of a second seed in the fruit. h, i, detached cotyledons from the side and adaxial angle respectively, with a fragment of the axis within the edge at *a*. j, fragments of receptacle with pericarp and testa; smaller fragments still adhere to the embryos a and d.

From colour transparency.

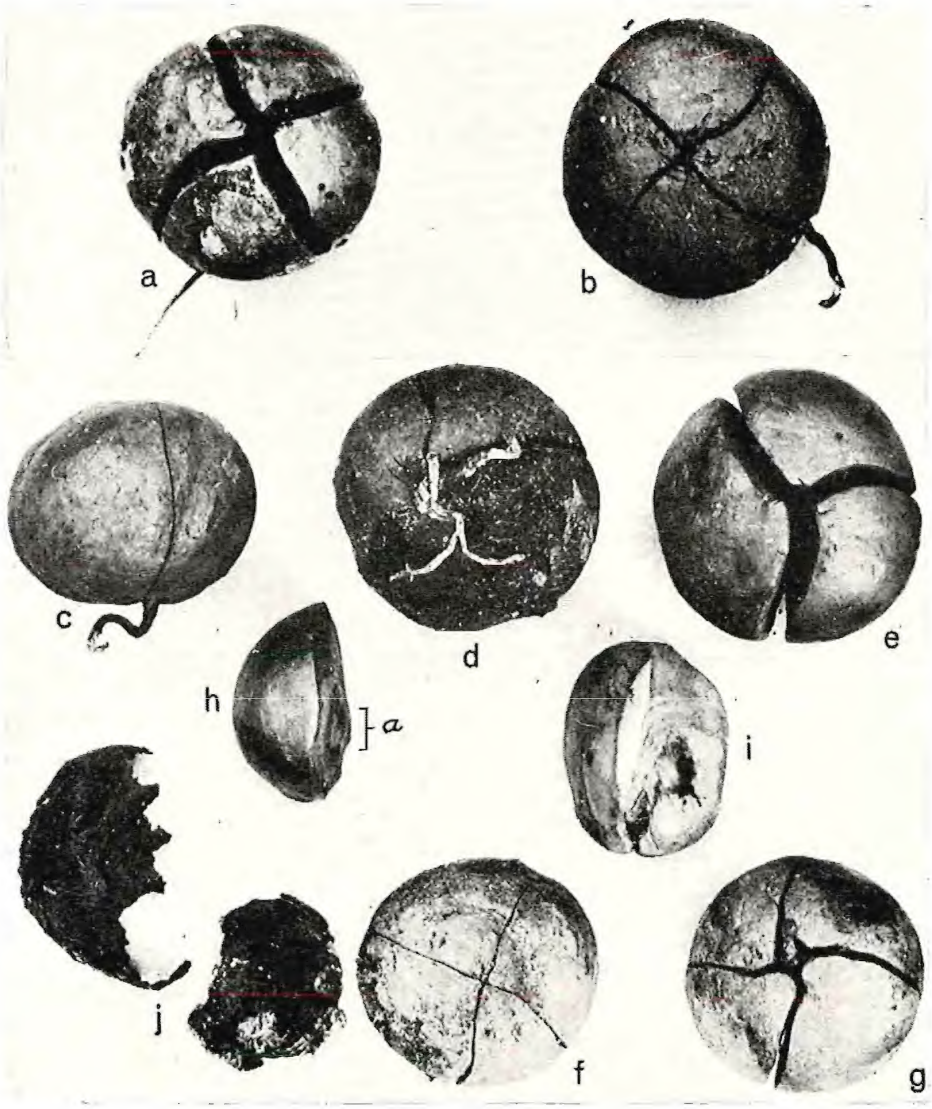

a
b
c
d
e
h
a
i
j
f
g

FIG. 7. Seedlings of different ages, half natural size. b, early stage of a shoot nearly facing the observer with scale leaves in 3's; c, embryo that has germinated upside-down with two shoots, the smaller one from the axil of a cotyledon; d, an asymmetric embryo apparently from a 2-seeded fruit.

From colour transparency.

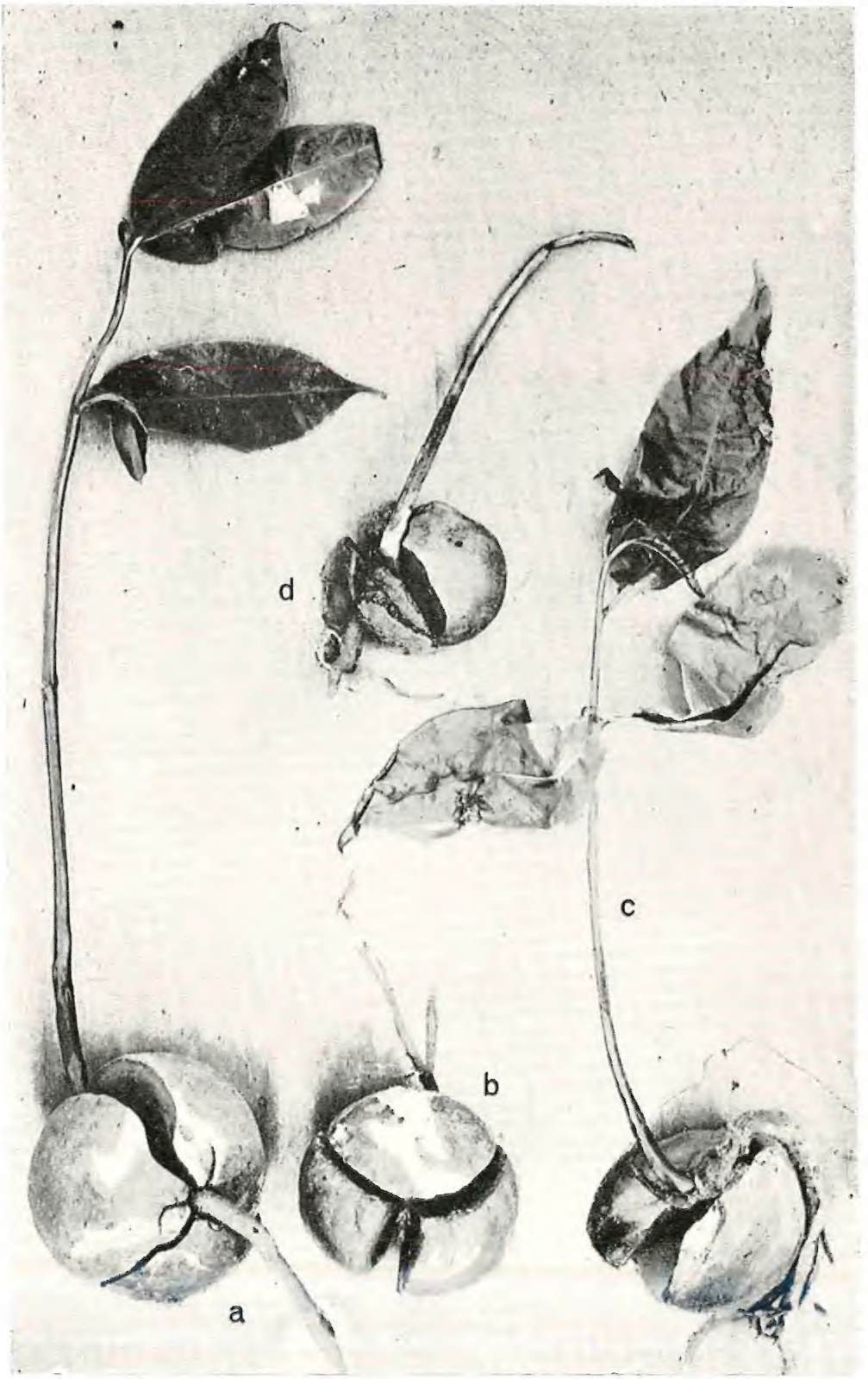

d
c
b
a

FIG. 8. a, flower in median longitudinal section, outer tepals fallen away (see also Fig. 4); b, flower in transverse section about half-way up the ovary, partly diagrammatic; c–f, tepals, outlines only, showing variation from outermost to innermost with transverse sections (except d) at about a third of the length above the base; c, d, outer deciduous tepals; e, f, inner persistent tepals; g, stamen, side view with a tepal at left cut along its length and a staminode at right in nearly median longitudinal section showing the hollow interior; h, stamen, oblique view from above showing anther cells; i, stamen, transverse section—note hollow above vascular trace; j, pollen grain (see also Fig. 11); k, ovary, vertical section; l, stigma, from above; m, twig, transverse section through node; n, twig, transverse section through internode; o, petiole, transverse section through distal part; p, base of leaf-blade showing venation, the margin dotted. a–i, p, × 5; k, l, × 20; j, × about 700; m, n, o not drawn to scale and partly diagrammatic so that xylem is represented by cross lines, phloem by dotted areas and sclerenchyma by solid black.

The figure of the pollen grain j is not correct—see Postscript on p. 11.

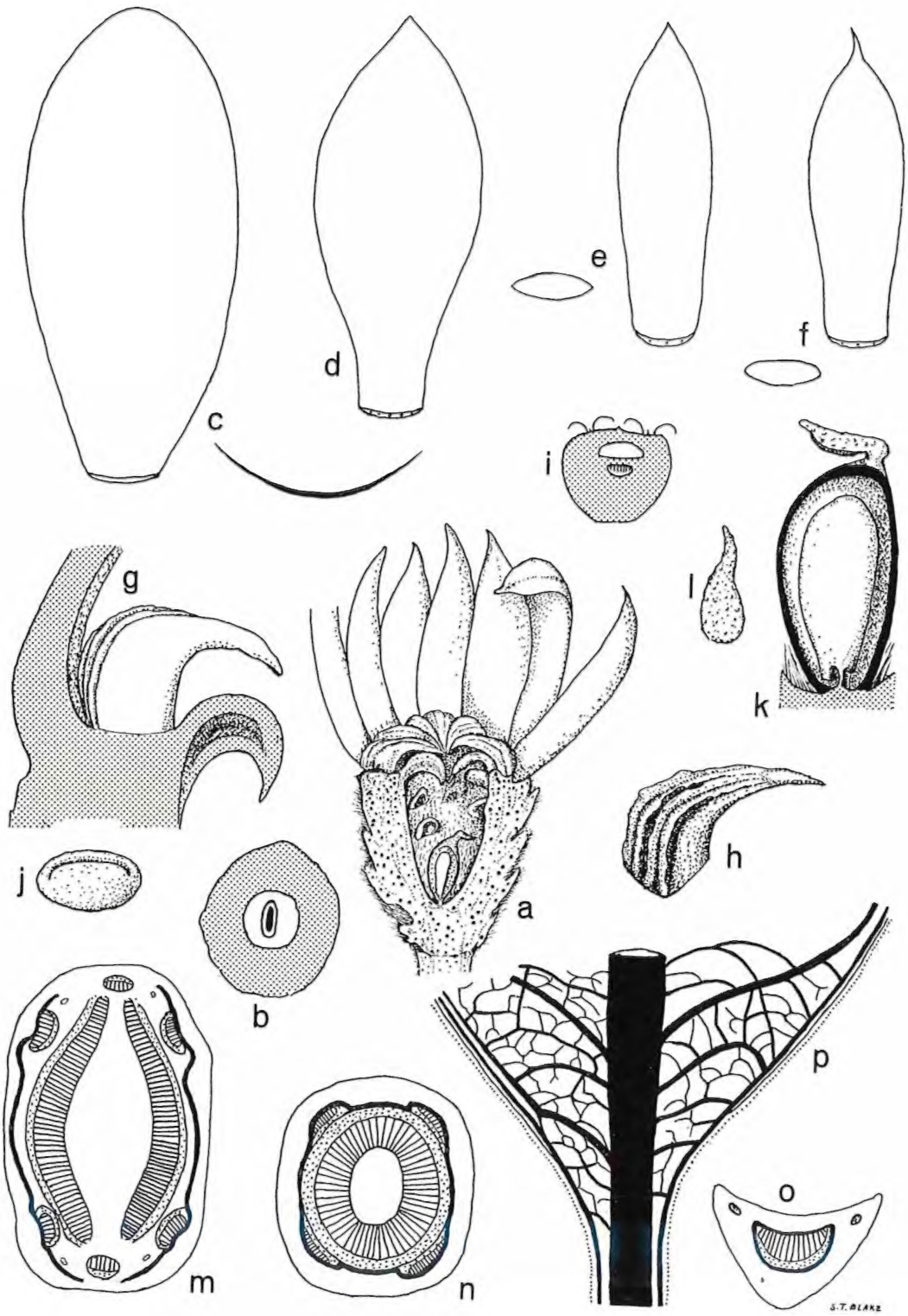

c
d
e
f
i
g
l
k
a
h
j
b
p
o
m
n
S.T. BLAKE

FIG. 9. Tracing of sketch of leaf and flower from type of *Calycanthus australiensis* annotated by Diels. (See text).

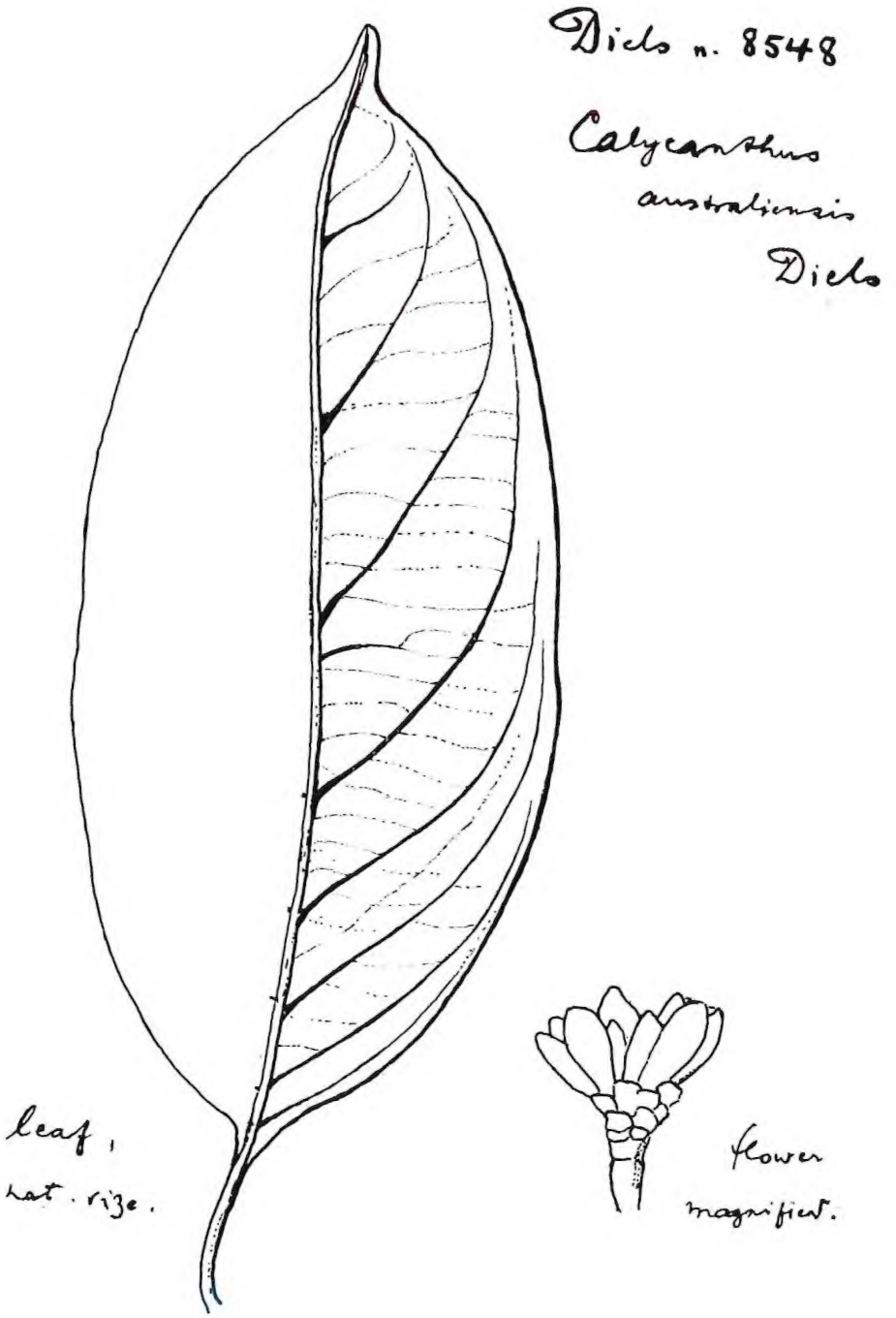

Diels n. 8548
Calycanthus
australiensis
Diels
leaf,
nat. size.
flower
magnified.

FIG. 10. Leaf venation from photographs of skeletons. a, from middle part of a leaf 25 cm long, × almost 3; b, a smaller leaf about natural size; c, part of b × 2 showing details of margin obscured in a by persistent sclerenchyma and other tissues. Free vein endings appear to be more numerous than they really are because many veinlets of the reticulum have broken away from larger veins.

Photos: A. Bolin.


a
b
c

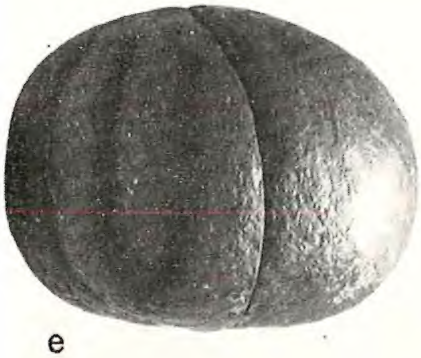
FIG. 11. Pollen, electroscan photographs. a, × 2000; b, × 2200; c, × 3600; d, × 4500. The pollen was taken partly from dry flowers of fallen tree (see text) and partly from a flower past anthesis preserved in FAA. There was no other treatment. The figure should also be looked at from the side.

Photos: University of Queensland Electron Microscope Unit. By courtesy of Dr. H. T. Clifford.


a
d
b
c

FIG. 12. Fruits and seed from *Hyland* 2569 R.F.K., natural size. a, b, fruits from the side; c, same fruit as a from above; d, part of receptacle; e, f, seed from side and in vertical section, both with 3 (of 4) cotyledons visible. The cracking of the receptacle caused by the fall of the fruit can be seen in a and c, and in c the persistent tepals and stamens can be seen separately. Visible in d are the outside surface (*x*), the brittle outer wall (*o*), the spongy inner part (*i*), the combined pericarp and testa partly separated from the receptacle after removal of the embryo (*p*), the hilum (*h*), and the stigmatic region (*s*) with the chalaza immediately below.

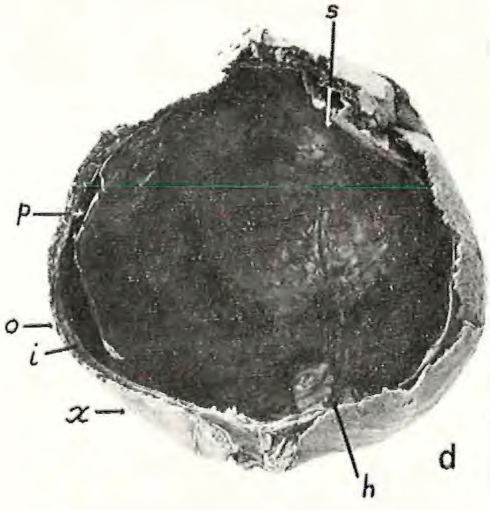
Photos: A. Bolin and S. T. Blake.



e

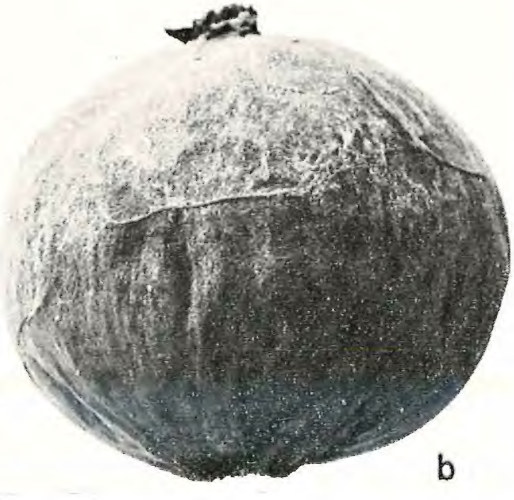
f

c



d

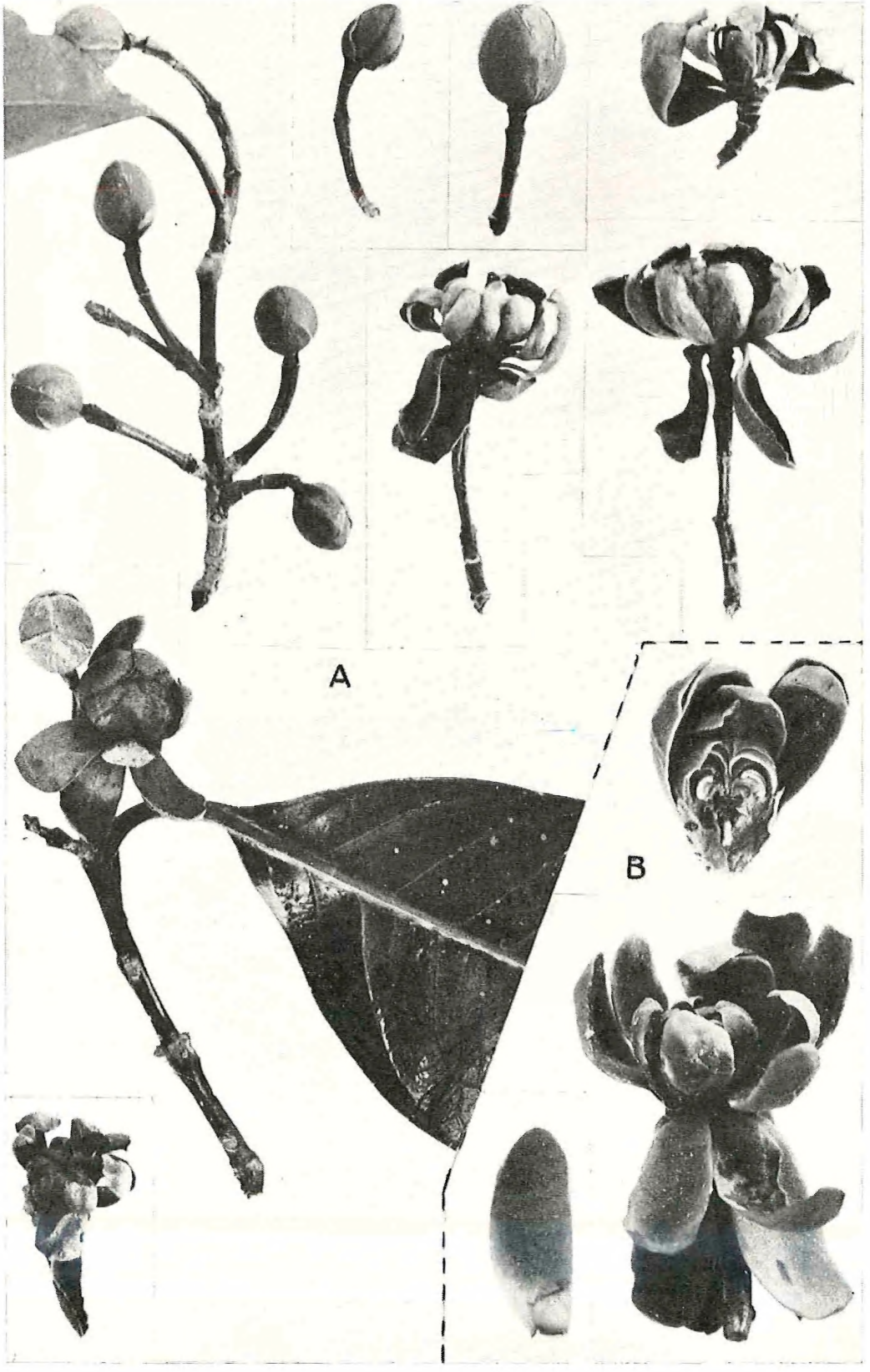
a



b

FIG. 13. A, buds and flowers from *Nicholas in Blake* 23783, natural size. B, bud in vertical section and flower with one fallen tepal from *Webb & Tracey* 10745, × 2. See Postscript, p. 11.

Photos: S. T. Blake and A. Bolin.


A
B